SPONDYLOLISTHESIS IN A CITY IN SOUTH SOUTH GEO-POLITICAL ZONE OF NIGERIA

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ABSTRACT

Background

Spondylolisthesis is a condition where one vertebra slips over the top of the adjacent vertebra. This is commonest in the lumbar spine.

Objectives

To audit lumbo-sacral spine radiographs for spondylolisthesis with emphasis on localisations, sex distribution, types and grading.

Materials and methods

A descriptive cross sectional study from 1st May, 2011 to 21st June, 2012. Recruited patients were referrals to Radiology Department, University of Uyo teaching hospital, Uyo, Nigeria for lumbo-sacral radiography irrespective of indications. Anterior-posterior and lateral radiographs of the lumbo-sacral spine were taken under standardized conditions. Radiographs with spondylolisthesis were identified and analysed statistically using computer SSPS 13.

Results

249 Patients were studied (132 Males and 117 females). 9.24% (n=23) of the studied population had 25 individual vertebral displacements. 82.61% (n=19) of these patients were females and 17.39% (n=4) were males (female to male ratio - 4.75:1). The mean age for males with vertebral displacement was 44.5 (S.D=10) while the mean age for females was 44.5 (S.D=15.81).
The commonest level of vertebral involvement was L4 on L5. This was seen in 56.52% (n=13) of patients with positive cases of spondylolisthesis. This was followed by L5 on S1 with 30.43%. 82.61% of patients had grade 1 displacements.

Degenerative spondylolisthesis was the commonest type (52.17%), followed by isthmic type (21.74%), uncategorised (17.39%) and traumatic spondylolisthesis (8.70%).

Conclusion

Radiographic pattern of spondylolisthesis in Uyo, Nigeria demonstrates the usual female gender bias, L4/L5 localizations but interestingly show predominance in degenerative spondylolisthesis.

Keywords

Spondylolisthesis, Lumbo-sacral radiographs, Degenerative.

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INTRODUCTION

Spondylolisthesis is anterior or posterior slippage of a vertebra or the vertebral column in relation to the vertebrae below. Such forward slippage is referred to as anterolisthesis, while backward slippage is retrolisthesis (Irani, Z. 2004).

Spondylolisthesis was first described in 1782 by Dr Herbinaux, a Belgian obstetrician. He reported in a small number of patients, a bony prominence anterior to the sacrum that obstructed the vagina (Chain, J.C. et al. 2004, Wikipedia, 2008). The term “spondylolisthesis” was coined in 1854, from the Greek words spondylo, meaning spine, and listhesis, meaning to slip or slide (Wikipedia, 2008).

Aetiologically, there are five major types of lumbar spondylolisthesis. Based on Wiltse classification system, there are dysplastic, isthmic, degenerative, traumatic, and pathologic spondylolisthesis (Irani, Z. 2004, Wikipedia, 2012, Eck, J.C. 2012, Li, Y., Hresko, M.T. 2012).

Isthmic or spondylolytic spondylolisthesis (ISS) is due to a defect (spondylolysis) in a portion of the vertebra called the pars interarticularis (Niggemann, P. et al 2012). Pars interarticularis is defined as the parts of the neural arch that lies between the superior and inferior articular facets (Irani, Z. 2009, Sirkis, H.M 2005). It is also roughly the region of the junction of the pedicle and lamina. ISS can be caused by repetitive trauma and this is more common among athletes (Irani, Z. 2009, Eck, J.C. 2012, Toueg, C.W. et al. 2010). Toueg, et al 2010 observed in their study that 75% of spondylolysis cases develop into spondylolisthesis. The spectrum of disease in ISS range from bone stress (earliest sign) through spondylolysis (a non-displaced fracture of the pars interarticularis) and spondylolisthesis (Zukotynski, K. et al. 2010, Ulmer, J.L. et al. 1997). Anatomically defined factors, such as sagitally oriented facet joints, increased pedicle-facet angle, and horizontalisation of the lamina, are non-modifiable aetiologic factors of spondylolisthesis (Chain, J.C. et al. 2004, Aono, K. et al. 2010).

Degenerative spondylolisthesis (DS) occurs due to cartilage degeneration and arthritic changes in vertebral joints. (Irani, Z. 2009, Eck, J.C. 2012). It is more common in older patients with slippage occurring in an intact neural arch (Eck, J.C. 2012).

Traumatic spondylolisthesis is due to direct trauma or injury to the vertebrae. This can be caused by a fracture of the pedicle, lamina or facet joints that allows the anterior portion of the vertebra to slip forward with respect to the posterior portion of the vertebra (Irani, Z. 2009, Eck, J.C. 2012).

elements due to tuberculosis may place excessive stress on the posterior elements thereby precipitating spondylolisthesis. (Chadha, M. et al, 2006).

Spondylolisthesis is equally graded and this is based on severity of slip. The most commonly used is Meyerding grading system (Wikipedia, 2008, Niggeman, P. et al. 2012). This is based on the ratio of amount of slippage to vertebral-body width obtained as a percentage (Irani, Z. 2009, Wikipedia, 2008, Huang, K. et al. 2009). This is best achieved with lateral lumbo-sacral radiographs. Here measurements of the distance from the posterior edge of the superior vertebral body to the posterior edge of the adjacent inferior vertebral body is made. This distance is then reported as a percentage of the total superior vertebral body length. (Irani, Z. 2009, Wikipedia, 2008). Grade 1 is a ratio of 0-25%, grade 2 is 25-50%, grade 3 is 50-75%, and grade 4 is 75-100% (Irani, Z. 2009, Bock, C., Sock, K. 2004, Stanislavky, A., Gaillard, F. 2005). When slippage is over 100%, it is called Spondyloptosis. In this condition, the vertebra completely falls off the supporting vertebra. (Wikipedia, 2008, Bock, C., Sock, K. 2004, Stanislavky, A., Gaillard, F. 2005). This was later added as grade V describing the ptosis of the cranial vertebra (Niggeman, P. et al. 2012).

Another grading system simply categorises spondylolisthesis as either low or high grade. Low grade spondylolisthesis is a slip that is less than 50% whereas greater than 50% is high grade (Wikipedia, 2008).


Spondylolisthesis is one of the diagnoses conventional radiography is unambiguous about. In this regard, lateral view can be used both for grading and classification. Lateral view is specifically useful in detecting spondylolisthesis as it may demonstrate the pars defect. (Irani, Z. 2009, Niggeman, P. et al. 2012). This in combination with other views can hazard instigating pathology. In addition, ancillary conditions related to spondylolisthesis like
vertebral formation anomalies, spondylosis, osteoid osteoma, Paget disease, fractures and osteolytic lesions are readily detectable with conventional radiography (Irani, Z. 2009).

To explore spondylolisthesis in a Nigerian population should be considered meaningful since when symptomatic can increase work absenteeism. Hence, taking a toll on economic resource of a developing nation. Our objective is therefore to audit lumbo-sacral spine radiographs for spondylolisthesis with emphasis on localisations, sex distribution, types and grading.

**MATERIALS AND METHODS**
Consecutive Patients who came for lumbo-sacral radiographs on any account were prospectively studied from 1st May, 2011 to 21st June, 2012. These patients were referred to Radiology Department, University of Uyo Teaching Hospital, Uyo, Akwa Ibom State, Nigeria both from within and outside the hospital. Their clinical and demographic data were extracted, Patients’ consents were sought prior to radiographic examinations. Lumbo-sacral spine radiograph for each patient was taken according to standard protocol with centring point at L2.

In anterior-posterior view, patient lies supine in the centre of an x-ray couch with arms and hands to the side of the body. The knees are raised with the soles of the feet resting on the couch top to reduce lumbar curve to minimum. The trunk is ensured to be straight and the pelvis not rotated. Patient’s shoulders and raised legs are supported on pillows to immobilize the patient. Anatomical marker is placed, beam collimated and gonad shield applied. Centring point is midline at L2. The direction of central ray is directed 90 degrees vertically to the centre of the film. Focal film distance is 90cm and exposure is made at arrested respiration in a 30 X 40cm detail or fast screen cassette.

In lateral view, patient lies in left lateral position but with the arms raised to the head and the head supported on a pillow. The hips and knees are flexed with the legs placed in a comfortable positions using sandbags. Centring point is 10cm anterior to the spinous process of L2. Direction of central ray is also vertical at 90 degrees to the film.

Paired radiographs of anterior-posterior and lateral per patient were used for evaluation of any vertebral displacements and associated pathology. Lateral radiographs were specifically used for grading of spondylolisthesis using Meyerding grading system.

Exclusion criteria included non-optimal and non-standardized radiographs as well as patients without complete bio-data.

Results were analysed using SPSS 13.0 for Windows software package (SPSS, Chicago, Ill).
RESULTS

249 Patients were studied with 132 Males and 117 females giving a male to female ratio of 1.13 : 1. The youngest age range was second decade of life. Studied population in both sexes increased progressively down the ages, peaking at 5th decade of life. This subsequently and progressively decreased to 8th decade of life. At the peak population, males were 30 (22.73%) in number and females were 38(32.48%). Twenty-three patients constituting 9.24% of the studied population had vertebral displacements. Of this number, 19 patients (82.61%) were females and 4 patients (17.39%) were males giving a female to male ratio of 4.75:1 (See table 1). The mean age for males with vertebral displacement was 44.5 (S.D=10) and mean age for female was 44.5 (S.D =15.81). 25 individual vertebral displacements were seen in these 23 patients. In females, the modal age for vertebral displacement was 54.5 while it is 44.5 for males.

The commonest level of vertebral involvement was L4 on L5, seen in 13 patients constituting 56.52% of positive cases of spondylolisthesis (See table 2). This was followed by 7 patients (30.43%) at vertebral L5 on S1. L1 displacement on L2 and L3 on L4 were seen in 2 patients (8.70%) each.

Grade 1 spondylolisthesis was the commonest grade (see figure 2). Twenty-one (91.30%) patients had Grade 1 displacements with female to male ratio of 6 : 1. Grade 2 was 4.35% (n=1), grade 3 0% and grade 4 was 4.35% (n=1) with one spondyloptosis. All the patients with grades 2 and 4 spondylolisthesis were less than 50 years of life. Whereas 61.90% of patients with grade 1 spondylolisthesis were above 50.

DS was the commonest type with 52.17% (n=12). Isthmic type 21.74% (n=5), traumatic type 8.70% (n=2) and uncategorised 17.39% (n=4). 100% of all degenerative spondylolisthesis had disc space narrowing at the site of listhesis.
Anterolisthesis (91.30%, n=21) predominates over retrolisthesis (8.70%, n=2).

**DISCUSSION**

Contrariwise to previous studies that observed predominance of isthmic spondylolisthesis, our study showed a predominance of DS (Irani, Z. 2009, Chain, J.C, 2004, Wikipedia. 2008). This may not be unconnected with sample bias, choice of radiological modality and the radiographic views deployed in this study. The sample bias was beyond our control as our study was simply a reflection of who gets referred for x-ray of the lumbo-sacral spine. Also, since the symptomatology essentially revolves on low back pain (LBP), the epidemiology of the studied population naturally skewed towards mid- and older age groups. Studies found out that the incidence of LBP is highest in the third decade, with overall prevalence increasing with age until the 60-65 age group, thereafter gradually declines. (Hoy, D. et al. 2010). In our environ, LBP is treated with levity and dismissed as inconsequential needing no investigations. Investigations become compelling when LBP becomes intractable, persistent or chronic. Therefore, any local study on LBP related entity will invariably means advancing age inclusive study. Little wonder our studied population subsets that were 40 years and above were 78.31%. This will impact on spondylolisthesis evaluations. DS is peculiar to this category of age group unlike isthmic type in young athletics (Zukotynski, K. et al. 2010). In fact, it is a disease of the older adult and rarely occurs before the age of 50 years (Wikipedia, 2008, Eck, J.C. 2012, Ulmer, J.L. et al. 1994). The correlation to age is a fallout of facet arthritis and facet remodelling (Chain, J.C. 2004, Wikipedia, 2008). As the facets remodel, they take on a more sagittal orientation, allowing a mild slip to occur (Wikipedia, 2008). This facet remodelling in part accounts for the
associated narrowing of disc space (seen in 100% of our cases{Fig. 4}) and central spinal stenosis at the level of the translation in DS unlike wide canal sign in ISS (Wikipedia, 2008, Toueg,C.W.2010,Ulmer,J.L. et al. 1994).

Another reason for predominance of DS in this study is due to its asymptomatic nature though it can be associated with symptomatic spinal stenosis (Eck, J.C. 2012, Niggemann,P. et al 2011). Correspondingly, these patients will present for radiography at an older age when the spondylolisthesis has now been made symptomatic by an attendant disc-vertebral disease. This will naturally elevates the incidence of DS. Diagnosis of DS is made when in addition to vertebral displacement, other features like osteophytosis, disc space narrowing, end-plate sclerosis are seen (Pye,S.R. et al. 2007) {See figs 4 & 5}. But these features being antecedental or sequential to spondylolisthesis are precarious.

Bilateral pars defect is needed to allow slippage in ISS and this is harbingered by trauma and fractures (Irani, Z. 2009, Bock,C., Stock, K. 2004) {See fig. 6}. Sport specific manoeuvres with repetitive twisting, rotation and hyperextension (like gymnasts, football linemen and ballets) increase load on the spine resulting in stress injury and ISS (Irani, Z. 2009, Chain, J.C. et al. 2004, Eck,J.C. 2012, Bock,C., Stock, K. 2004, Zukotynski, K.et al. 2010, Niggermann, P. et al. 2012, Yoong-Leong, J. et. 2012, Toueg,C.W. 2010). Most of our patients were relatively beyond the age ceiling for aggressive sports. Therefore the low percentage of ISS in our study is two pronged. Our recruitment was less of young people and our methodology was bereft of bilateral oblique-lateral lumbo-sacral spine radiographic views. On exploit of the later, higher sensitivity is achieved in delineation of spondylolysis, a sine qua non in diagnosis of ISS (Chain, J.C. et al. 2004). Since this was not at our disposal, a few spondylolytic lesions may have been missed, resulting in misclassification of some identified spondylolisthesis (Chain, J.C. et al. 2004) These were regarded as uncategorised in this study as they have neither pars interarticularis defect, degenerative changes, bone pathology nor arose from trauma.
Spondylolysis may not always be visible on lateral radiographs (Irani, Z. 2009). More modern modalities like magnetic resonance imaging (MRI), computed tomography (CT), and single photon emission computed tomography (SPECT) arranged in increasing order of sensitivity in detecting pars articularis defect would have changed our observed trend (Irani, Z. 2009, Zukotynski, K. et al. 2010, Huang, K. et al. 2009).

The entire observed traumatic spondylolisthesis had sinister clinical presentations of paraplegia with horrendous culprit being road traffic accident (RTA). RTA and falls are the commonest causes of bilateral avulsion of the neural arches from the vertebral body with or without subluxation (Sirkis, H.M. 2005). It is not unusual that dysplastic and pathological spondylolisthesis were not seen in this study as they are rare entities (Wikipedia. 2008, Chadha, M. et al. 2006).

In agreement with other studies, the preferential localization of spondylolisthesis in this study was L4 on L5 followed by L5 on S1 (see table 2 and fig 4) (Eck, J.C. 2012, Huang, K. et al. 2009, Bock, C., Stock, K. 2004, Aono, K. et al. 2010). This is linked to vulnerability to micro-trauma from repetitive flexion, extension, rotational forces or increased loading on lower lumbar vertebrae. (Zukotynski, K. et al. 2010, Toueg, C.W. 2010). Anatomic predisposition also favours this site irrespective of being degenerative or isthmic. Progression of wedge values down the spine, increase in caudal vertebral body height with decrease in posterior elements in the lower lumbar region to create lumbar lordosis encourage spondylolisthesis. (Wilms, G. et al. 2009). Furthermore, the increased incidence of L5 spondylolisthesis could be due to the complementary role of anterior-posterior lumbo-sacral radiograph. This peculiarly appears as inverted Napoleon Hat sign. (Gentili, A. et al 2000). Here the anterior border of the transverse process of L5 is in continuity with the anterior border of the body of the same vertebrae in frontal radiograph with projection of anterior border of L5 against the shadow of sacrum (Gentili, A. et al 2000).
Despite the unintended male bias in our recruitment, in general there is still an overriding incidence of spondylolisthesis among females (See table 1 and figure 1). This female tilt has been noticed in other studies (Chain, J.C. et al. 2004, Wikipedia, 2008, Eck, J.C. 2012, Wilms, G et al. 2009). This disproportionate sex ratio has been unaccounted in the literatures. Future studies on interrelationship of spondylolisthesis and sex hormone profiles will therefore be exciting.

Grade 1 spondylolisthesis predominates just like in other studies (Wikipedia, 2008, Eck, J.C. 2012). (See figure 2). It is noteworthy that all our patients with grades 2 and 4 spondylolisthesis were less than 50 years of age whereas 61.90% of grade 1 spondylolisthesis were above 50. This implies that more forceful impact readily associated with youthfulness is needed in the aetiogenesis of high grade spondylolisthesis. High-grade slips are much rarer, less than 10% of spondylolisthesis, and majority present during adolescence. (Wikipedia, 2008, Dernard, P.J. et al. 2010). This is comparable to our 4.35% and younger age group.


The limitation of this study is the non-utilization of bilateral oblique-lateral views. This may probably increase the incidence of isthmic spondylolisthesis in our environment but our patients were not just ready to tolerate further receipt of radiation dose. Nevertheless, we think this drawback does not understate our findings as lateral radiograph still serves as alternative in detecting spondylolysis, hallmark of isthmic spondylolisthesis.
CONCLUSIONS

There is a disproportionate female gender bias in spondylolisthesis in Uyo, Nigeria. While the typical predominance of grade 1 and slippage localisation of L4 on L5 are obeyed, contrariwise, degenerative spondylolisthesis predominates over the usual isthmic type.

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Staff of Radiology Department, UUTH, Uyo, Nigeria

Competing interests

The authors declare that they have no competing interests

Authors’ contributions

This work was done in collaboration with all authors. UFU conceived and designed the study. UFU and DEN wrote the protocol and the first draft of the manuscript. UFU, DEN, NTE, EDU managed the analysis, literature searches and tables/figures. All authors revised and approved the revised manuscript.

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### TABLE 1
SEX DISTRIBUTION OF SPONDYLOLISTHESIS

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### TABLE 2
VERTEBRAL DISPLACEMENTS WITH AGE RANGE
### Table 1: Sex distribution and age range of spondylolisthesis

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**Fig. 1.** Sex distribution and age range of spondylolisthesis
AGE RANGE
SERIAL 1=MALES, SERIAL 2=FEMALES

Fig. 2. Grading of spondylolisthesis.

Fig. 3. Lateral lumbo-sacral spine radiograph showing traumatic spondylolisthesis of L1 on L2 with focal lumbar spinal stenosis and anterior wedging of L1.

Fig. 4. Lateral lumbo-sacral radiograph showing Grade 2 spondylolisthesis with about 30% slip of L5 on S1 in a degenerative type of spondylolisthesis.
**Fig 5** – Anterior-posterior lumbo-sacral spine radiograph showing marginal osteophytosis L2-L5 with narrowed disc spaces seen in degenerative disc diseases.

**Fig 6** Lateral lumbosacral radiograph showing stress fracture of L4 pars interarticularis without displacement (Spondylolysis) – a forerunner of isthmic spondylolisthesis. Note narrowed L4/L5 disc space.